

adsorption ratio (SAR) and pH values do not have units.

EC indicates the amount of dissolved minerals in the water—primarily nitrogen, potassium, calcium, magnesium, sodium, chloride and bicarbonate. This measurement helps in evaluating water usability and the level of management required for specific uses.

SAR indicates the degree of balance among calcium, magnesium and sodium in water. It is useful in predicting the tendency for sodium to accumulate in soil where the water is routinely used for irrigation. Sodium can also be toxic to foliage when it accumulates on surfaces of leaves during overhead irrigation.

Total alkalinity is a measure of the carbonates (CO_3^{2-}) and bicarbonates (HCO_3^-) in a sample. It indicates the tendency of water to increase soil pH where irrigation is routinely used. In some plant-production systems, water alkalinity should be neutralized to support optimum plant growth. An acid requirement (AR) is given when appropriate and indicates the amount of battery acid needed to neutralize 80% of the alkalinity.

Hardness indicates the amount of calcium and magnesium in water and is expressed as equivalent calcium carbonate. It is useful in evaluating water quality for potential to form scale or deposits.

Nitrate nitrogen is measured for all surface and ground water samples. Normal background levels in surface and ground water range from 0 to 3 ppm. Elevated nitrate nitrogen of 3 ppm or higher may indicate human-induced contamination or environmental impact.

stewardship. Surface and ground water supplies should be sampled annually to verify that applications are not having a negative impact on the environment.

For additional information, contact

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Record Keeping

Detailed records of agricultural fertilizer and waste applications can be invaluable. Records document responsible nutrient management and environmental

Agronomic Division

Solution Analysis



*Fostering
Agricultural Productivity
& Environmental Quality*

**N.C. Department of Agriculture
and Consumer Services**

Steve Troxler, Commissioner

Water Quality in North Carolina

In our state, surface waters, such as rivers and lakes, account for 83% of the public water supply, primarily in the piedmont and mountains. The coastal plain depends largely on ground water. Five major aquifers supply ground water in North Carolina (Fig. 1).

Agriculture—irrigation, livestock and aquaculture—accounts for only 4.3% of our state's water use. Most irrigation water comes from surface supplies. However, trickle systems using ground water are becoming more prevalent.

Virtually all N.C. ground water meets drinking water standards. For water used in agricultural production, the most significant, naturally occurring problem is concentration of sodium and chloride at lower depths in coastal plain aquifers. Bicarbonates can also be high in ground water supplies and often increase with depth and proximity to the coast. Sometimes, levels of iron, manganese, sulfur and boron are also too high.

Excess fertilization, sewage spills or discharges, and malfunctioning animal waste lagoons sometimes cause high nitrate levels in water. Concentrations of nitrate in excess of 10 parts per million (ppm) are not safe for human consumption. On average, surface and ground water samples tested by the Agronomic Division from 1999 through 2007 contain only 1.5 ppm nitrate.

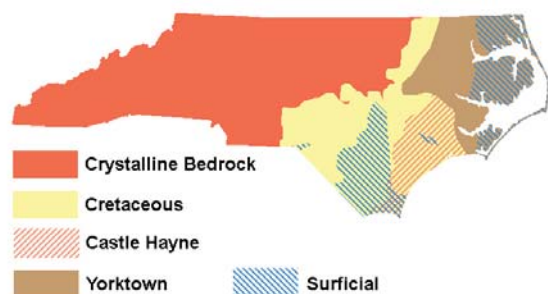


Figure 1. Principal aquifers in North Carolina

Purpose of Solution Analysis

The NCDA&CS Agronomic Division tests the suitability of source water or nutrient solutions for specific agricultural uses, such as irrigation, aquaculture, livestock and poultry watering, greenhouse plant production, trickle fertigation and the mixing of pesticide solutions. The test can also be used to monitor surface and groundwater quality.

Source water for agricultural operations should be tested annually. However, because periods of drought or excessive rain can alter pH and/or mineral concentrations, more frequent testing is sometimes advisable. When problems exist, monthly or quarterly sampling may be warranted.

NCDA&CS solution analysis measures concentrations of the elements P, K, Ca, Mg, S, Fe, Mn, Zn, Cu, B, Mo, Cl and Na. Additional determinations include ammonium nitrogen ($\text{NH}_4\text{-N}$), nitrate nitrogen ($\text{NO}_3\text{-N}$), urea, electrical conductivity (EC), pH, total alkalinity and hardness. In addition to analytical results, the report includes recommendations on usability, hazards and management strategies.

Solution analysis is not appropriate for detecting or identifying microorganisms or organic contaminants, such as pesticides or other harmful chemicals. Contact a private lab or the state health department about testing for these kinds of problems.

The Sample

Reliable solution analysis requires representative samples collected under the same conditions the solution will be used. Solution sampling procedures and sample information forms are available online (www.ncagr.com/agronomi/uyrpws.htm).

For each sample, collect a minimum of one pint of liquid in a clean, plastic container. Before filling the container, rinse it thoroughly with the solution being collected. Fill the container and cap tightly.

Fill out *Solution Sample Information* (form AD-7) in as much detail as possible. ***Information requested in the shaded areas of the form is critical for optimum diagnosis and recommendations.*** This information helps NCDA&CS agronomists interpret your test results correctly for the use you intend.

Refrigerate samples if they will be stored for more than one day before submission. For shipment, use a carrier such as Fed Ex, DHL or UPS, unless you can deliver them to the lab yourself. The fee for solution analysis is \$5 per sample.

Diagnosing Problems

Solution samples may be submitted for predictive or diagnostic analysis. Predictive analysis is useful for general monitoring of water quality or verification of nutrient solution content. Diagnostic analysis is helpful in identifying and managing site-specific problems.

Solution samples submitted for diagnosis of plant production problems should usually be accompanied by matching plant tissue and soil samples to help pinpoint the problem. Paired samples from problem and nonproblem areas provide the most complete set of evidence for evaluation. Samples of source water should also be taken when a nutrient solution is being evaluated.

All solution analysis test results are reviewed by agronomists. Data are interpreted based on details provided on the sample information form. The more background provided, the more specific the recommendations will be.

The Solution Report

Most results on the report are given in units of parts per million (ppm). Electrical conductivity (EC), or soluble salts, is in units of 10^{-5} S/cm. Sodium